A Comparison Study of Impact Hammers

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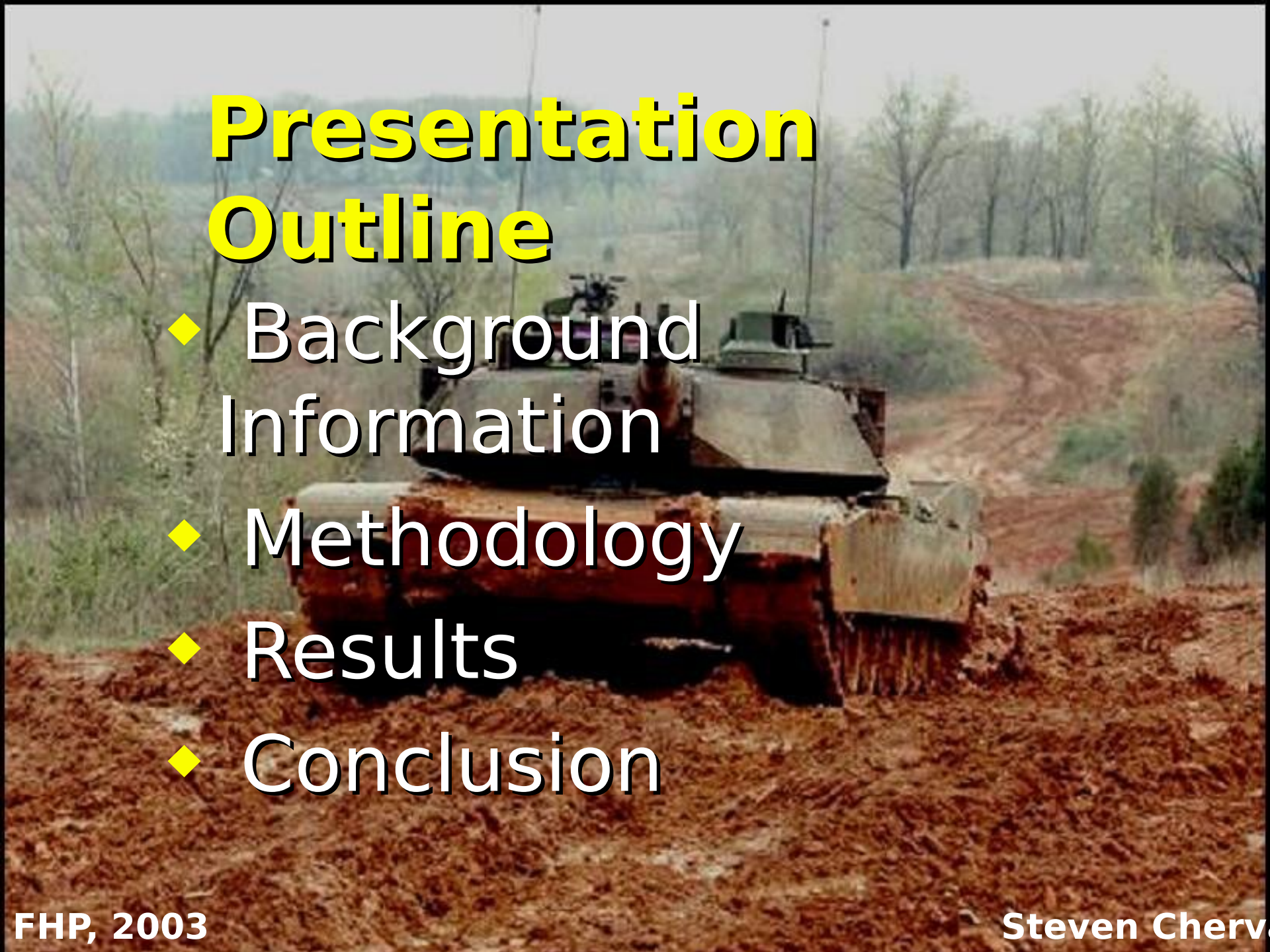
USACHPPM
Readiness thru Health



Presentation Outline

- Background Information
- Methodology
- Results
- Conclusion

Background

- Purpose of Project:

Evaluate effectiveness of replacing current tools with newer, better designed tools as related to:

- Productivity
- Vibration levels
- Worker's physiologic demand

Background

- Worker Focus Group
  - Anniston Army Depot
    - Injury records
    - Determine study focus
    - Problematic tool identification
- Initial Study
  - Anniston Army Depot
    - Tank Disassembly Line

Methodology

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Methodology -Subjects

- 11 Volunteer Subjects
  - Male
  - Avg. Age: 49.9 years
  - Time at Job: 12.1 years

Methodology - Tools

- Three – 3/8 Inch impact wrenches
  - Tool # 1 – New, Manuf. A
  - Tool # 2 – New, Manuf. B
  - Tool # 3 – Old, Manuf. C
- Similar Weight, Shape & Size

Methodology – Task

- Remove 4 bolts from wheel guard with each impact hammer/wrench.
  - Randomized order
  - Bolt tightened to 175 ft-lbs. prior to removal

Methodology - Measurements

- Productivity
- Electromyography
- Vibration

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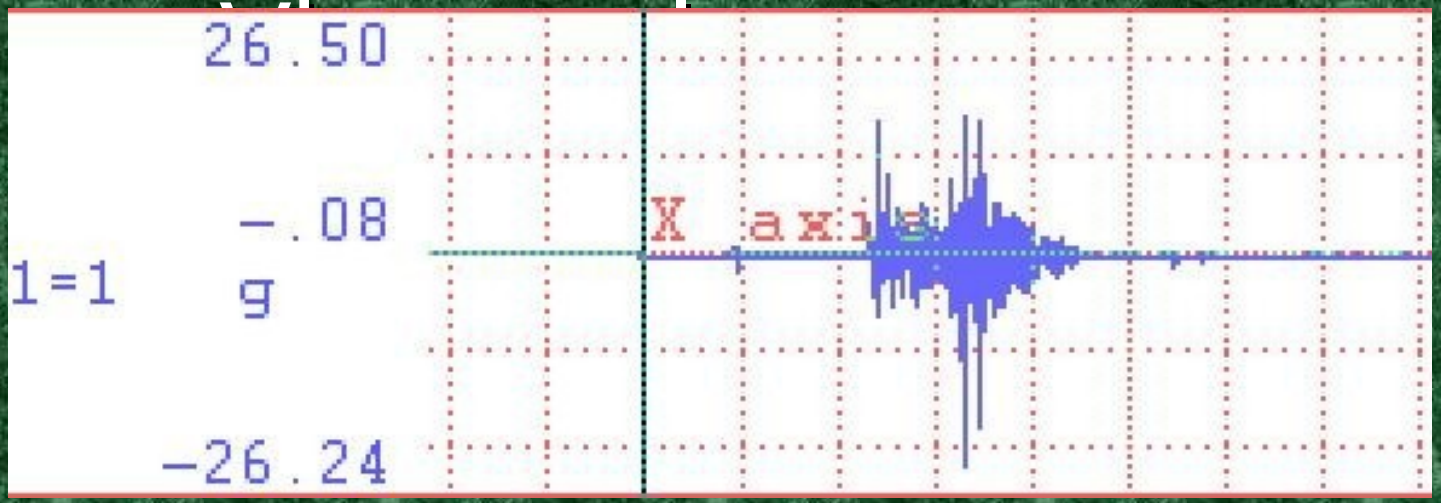
Measurements

- Productivity
  - Average Bolt Removal Time

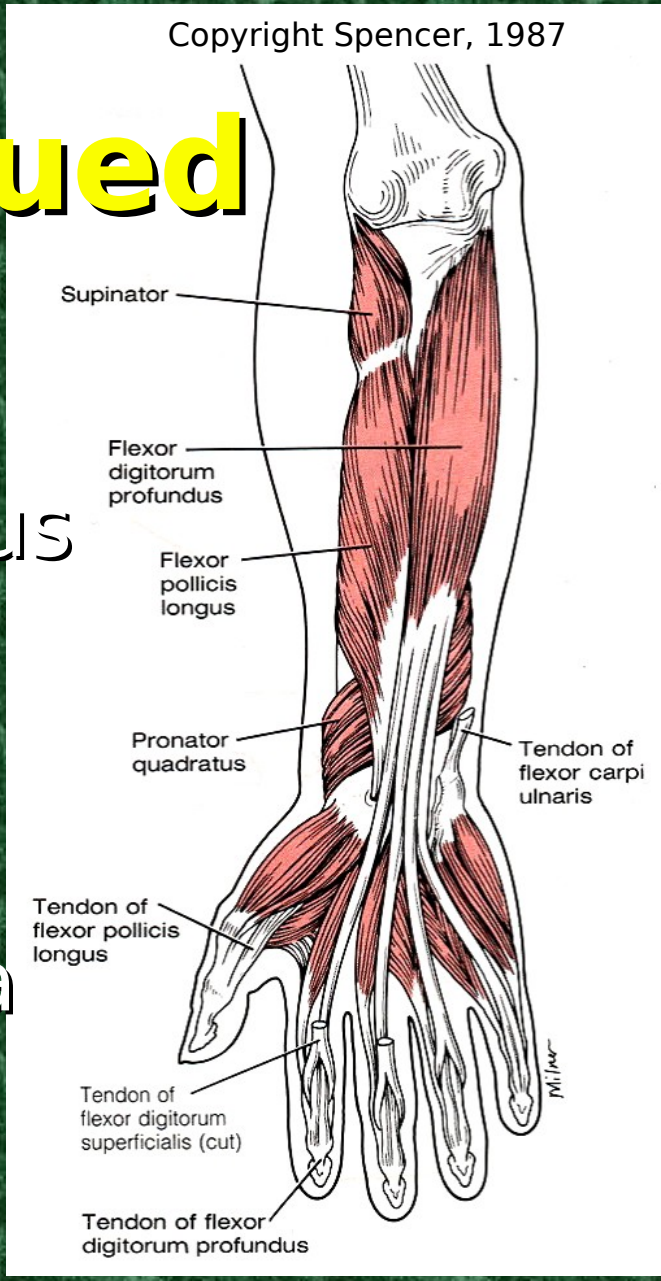


Measurements

- Electromyography (EMG)
  - Surface Electrodes
  - Band pass filter (13 hz – 150 hz)
  - Sampled at 200 hz
  - Full wave rectified

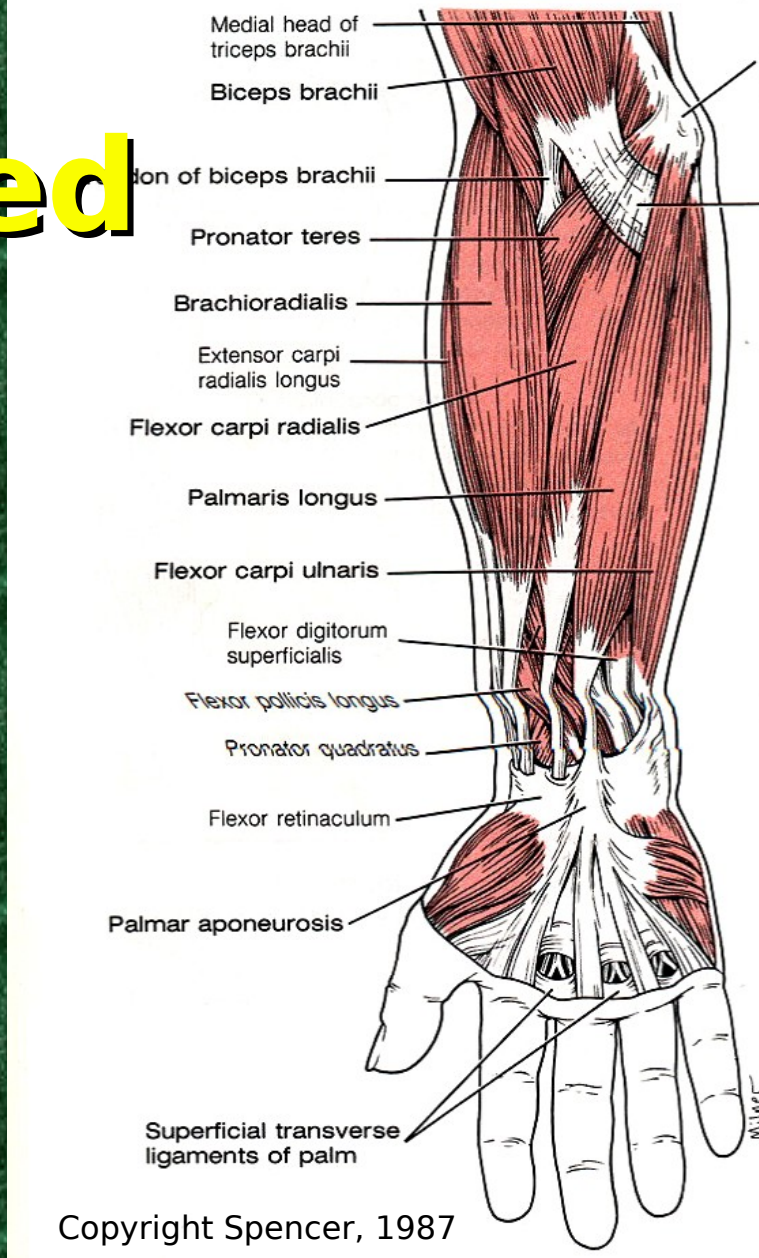
EMG - Continued

- Two muscles measured
  - Flexor digitorum profundus
    - Flexes phalanges and hand
    - % Maximum Voluntary Contraction (%MVC) via hand dynamometer



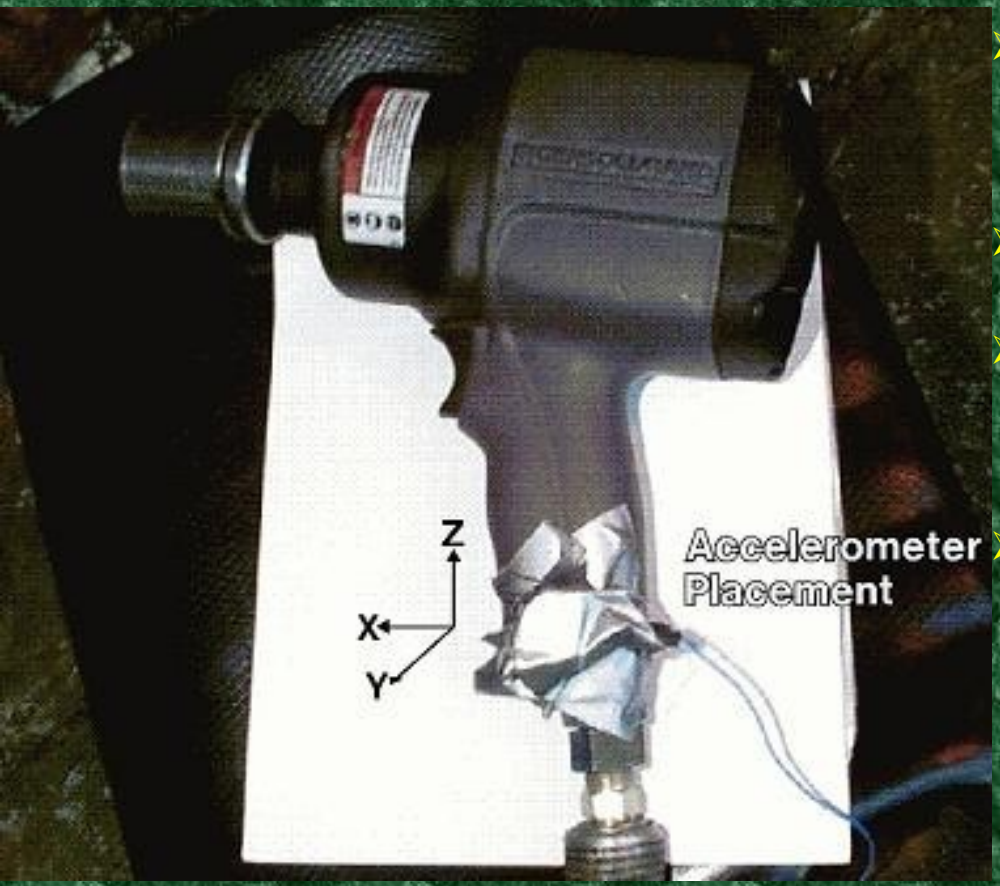
EMG - Continued

- Two muscles measured
  - Brachioradialis
    - Flexes forearm
    - % Maximum Voluntary Contraction (%MVC) via isometric contraction

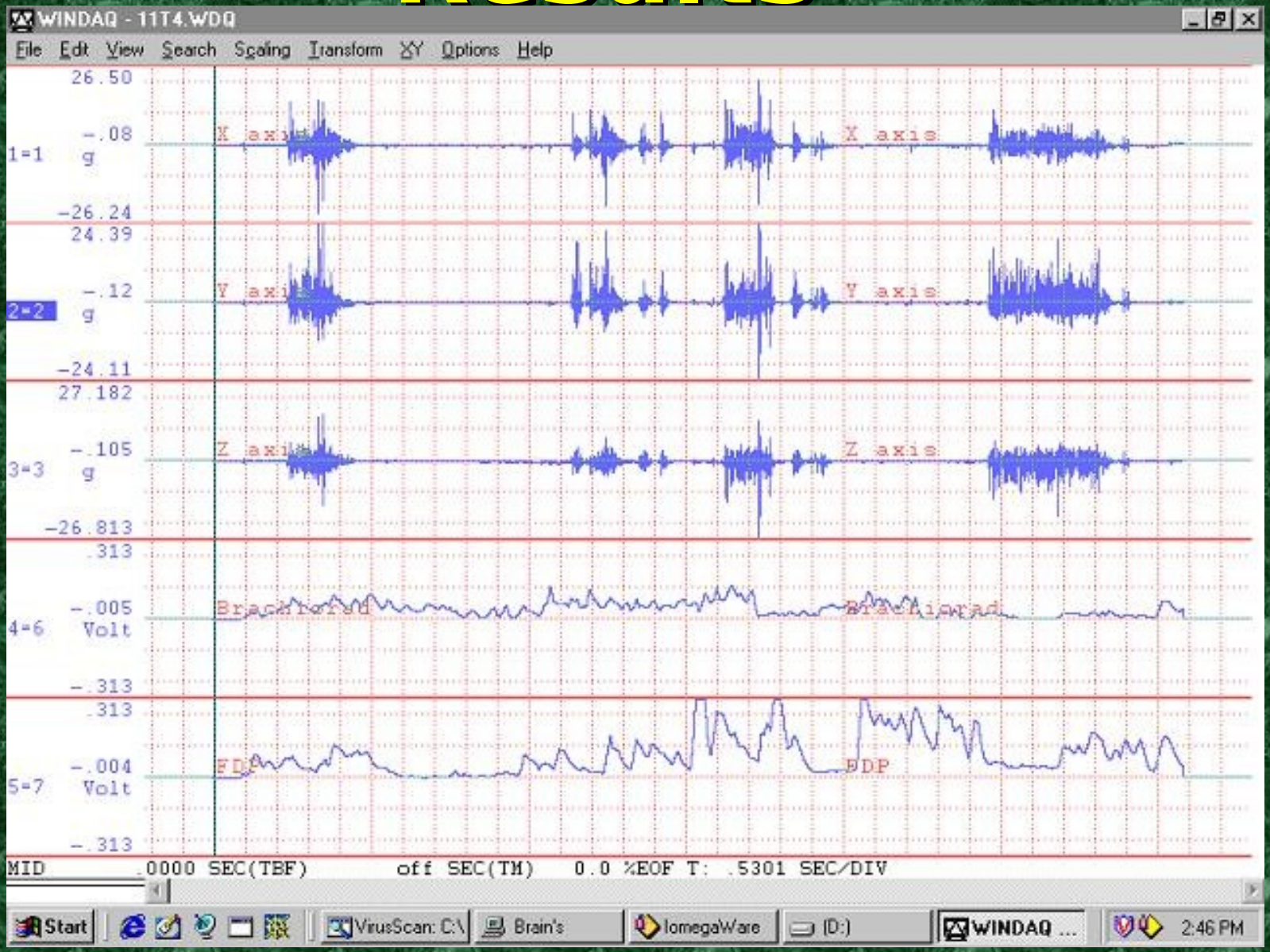


Measurements

- Vibration
  - 100 mv/g Triaxial Accelerometer
  - Sampled at 2000 hz
  - 1000 hz low pass filter
  - Root Mean Square (RMS) values



Results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Productivity - Bolt Removal Times

Tool Performance

Tool #	N	Mean	Std. Dev.	Minimum	Maximum
1 (New)	11	1.7256	0.3745	1.210	2.313
2 (New)	11	1.7300	0.3979	1.060	2.215
3 (Used)	12	7.6574	2.8631	4.408	11.868

ANOVA

	Sum of Sq	df	Mean Sq	F	Sig.
Hypothesis	235.112	2	117.556	48.199	0.000
Error	46.34	19	2.439		

Post Hoc Test for Bolt Removal

Student-Neuman-Keuls

		Subset	
Tool #	N	1	2
1	11	1.725	
2	11	1.730	
3	10		7.657
Sig.		0.995	1.000

Surface EMG Results

% MVC Flexor Digitalis Profundus

Tool #	Mean	N	Std. Dev.
1	24.135	10	18.184
2	23.266	10	14.635
3	19.255	9	8.636

ANOVA

	Sum of Sq	df	Mean Sq	F	Sig.
Hypothesis	992.707	2	496.354	0.673	0.523
Error	12541.859	17	737.756		

Surface EMG Results

% MVC Brachioradialis

Tool #	Mean	N	Std. Dev.
1	11.678	11	9.450
2	7.682	11	4.748
3	5.931	10	3.346

ANOVA

	Sum of Sq	df	Mean Sq	F	Sig.
Hypothesis	138.812	2	69.406	2.503	0.108
Error	526.857	19	27.729		

Vibration Results

Mean Accelerometer Values

Tool #	Xrms	Yrms	Zrms
1	7.806	6.589	3.554
2	4.409	1.629	1.896
3	22.613	45.224	3.599
Significance	0.000	0.000	0.003

Conclusions

- New impact wrenches performed significantly better than older tool.
- New impact wrenches had less vibration than older tool.
- Performance of new impact hammers were similar.
- Physiologic differences were negligible.

Future work

- Can we optimize tool replacement?
  - ½” impact wrench
  - Date in service
  - Cost
  - Service history
  - Vibration level/Production level

Lessons Learned

- Pilot Study, Pilot Study, Pilot Study.
  - Labs great – no substitute for reality
- Heavy tools – look at non-dominant hand
- 375 ft/lbs of torque is a lot of torque!

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